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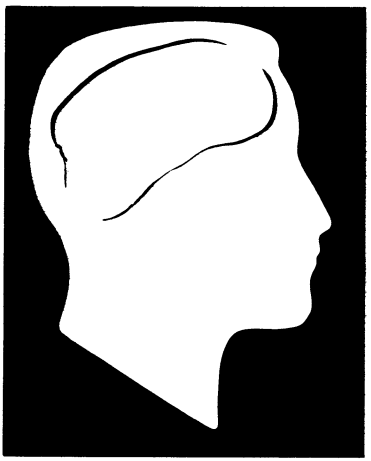

COMPU-MATH™: DECIMALS

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COMPU-MATH: DECIMALS

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ACKNOWLEDGEMENTS

COMPU-MATH: DECIMALS was developed exclusively by Edu-Ware Services, Inc., a California software development company dedicated to the production of instructionally valid C.A.I. and intellectually challenging games.

It took the efforts of a number of individuals to bring this product to fruition:

Sherwin Steffin created the instructional design which led to the development of the COMPU-MATH: DECIMALS Programs. He wrote all of the documentation, including the description of the Instructional Model.

David Mullich coded the entire series of Apple programs, initiating significant instructional changes during the process.

Robert McNally provided the coding for the Atari Version 1.0 of COMPU-MATH: DECIMALS.

Steven Barr was responsible for all system testing of the Atari Version of these programs.

INTRODUCTION:

A number of software development companies have, from time to time, produced materials which were designed to provide computer users with instruction in some subject areas. Among those areas of knowledge is frequently found an effort to produce instruction in the area of arithmetic. Since there are now a number of such programs available, it seems reasonable to ask, "Why another one?"

The authors of DECIMALS believe there are enough significant differences in these programs to make them worthy of purchase by the parent wishing to improve his child's skills in arithmetic, or the teacher wishing to employ instructional computer programs within the classroom. These important features include:

(1) Pre-Testing of the learner to assess current skill levels before entry into the Learning Programs. This Pre-Test gives the user direct information as to the specific skills he currently has, and then routes him to the appropriate beginning program.

(2) Skill development is expressed in terms of specific Performance Objectives which are made explicit to the learner before instruction begins in each Learning Unit.

(3) Major skill areas are identified and pooled within each Learning Program. These are:

DEC.1 - Definitions and Decimal Conversion

This unit introduces the learner to the concept of the decimal being another form of the

fraction. He is helped to gain skills in the conversion of fractions to decimals, and decimals to fractions. The concept of the decimal point and place holders to the right of the decimal point are introduced.

DEC.2 - Addition of Decimals

In this unit, the learner is introduced to the concept that the process of adding decimals is precisely the same as that of whole numbers. Replacement of trailing zeros to insure decimal placement and carrying of columnar values is developed.

DEC.3 - Subtraction of Decimals

Again, the concept of placement of trailing zeros is reinforced, as is the method of borrowing in subtraction. Emphasis is placed on the skill of subtraction as it is applied to either whole numbers or decimals.

DEC.4 - Rounding Off Decimal Numbers

Since the skill of rounding to a specified number of places is needed in the multiplication and division of decimals, this unit is presented before the Multiplication and Division units. The terms "Rounding to N decimal places," and "Rounding to N significant digits," are both developed and reinforced with practice.

DEC.5 - Multiplication of Decimals

The emphasis in this unit is placed on identifying the correct decimal point placement after multiplication is completed. Moreover, the learner is expected to round decimals to a specified number of places.

DEC.6 - Division of Decimals

To help the learner gain skills, the algorithm for long division is reviewed, and the learner is given practice in the process before going on to the division of decimals. As in the Multiplication unit, heavy emphais is placed on correct decimal point location.

DEC. 7 - Percentage

Conceptually, learners have great difficulty in mastering the computational skills associated with finding percentage, and the value of a number when multiplied by a given percentage. Heavy instructional practice is oriented to helping the learner acquire both skills, as well as in determining percentage change between to values.

(4) User Proofing is established through a number of methods which essentially make it impossible for the young user to "crash" the program, either through lack of knowledge, or desire to do so.

PROGRAM STARTUP

APPLE II, APPLE II+

If you are using an Apple II with Autostart you MUST have ROM Applesoft resident in the computer. Apple II's with Language Cards will not operate with these diskettes.

To operate, simply insert the diskette in the drive, and either boot it, or turn on the power switch in back of the computer. An Edu-Ware identification, and then a Menu will appear on the screen. Select the desired program from the Menu.

ATARI 800/810

This system is on two diskettes. Either diskette may be used to begin, with screen instructions appearing to tell you when to switch diskettes.

We STRONGLY recommend you back up both diskettes before using, since files may be easily lost. If you are unfamiliar with this procedure, consult your Atari Disk Manual.

When you are ready to start, turn off the power switches on both the disk drive, and the computer. Insert either diskette into the drive, and close the latch. Turn on the disk drive power switch FIRST. When Disk activity has stopped, turn on the computer. An Edu-Ware identification, and then a Menu will appear on the screen. Select the desired program from the Menu. If given screen instructions to do so, exchange diskettes and select the desired program from the second Menu.

USING THE PROGRAMS

As you look at the screen, you will see a Menu. This lets you make some choices about what you wish to do. The first choice on the Menu will read: "(1) Take the Pre- Test". Select the number of the program you wish to use and type that number. The program you have selected will quickly appear on the TV screen.

PRE-TEST

Now, you are ready to learn about decimals. The first step is to find out what you know already...so you don't have to waste your time doing something you already can do. That is what the Pre-Test is for.

In all of these programs, the computer tells you what

you need to do to answer the questions. Don't be worried that you will do something wrong...you won't hurt the computer, or mess up the program.

After you get through with the Pre-Test, the computer will recommend that you start with one of the Learning Programs and will give you the directions for loading the other disk.

THE LEARNING PROGRAMS

The Pre-Test is there to tell you what you now know. The Learning Programs are here to teach you something new. To do well in these programs, you need to have some skills with arithmetic. Here are the skills you will need to do well in these programs:

You should be able to:

(1) Add any two or three place whole numbers and get the correct answer.

(2) Subtract any two or three digit number from another like number.

(3) Multiply any two numbers together using long multiplication methods.

(4) Correctly divide any divisible number by any divisor and find the quotient and the remainder.

(5) Explain these terms:

- addend
- minuend
- subtrahend
- multiplicand
- multiplier
- divisor

- dividend
- quotient
- remainder

(6) Add, subtract, multiply, divide, and find the common denominator of any two fractions.

If you have difficulty with these skills, ask your teacher, or your parents, or an older friend for some help.

Some Hints to You:

(1) Take the programs in order. Each program depends on what you learned in an earlier program.

(2) Don't try and go through all of the programs at once. There is a lot of new material to learn, and you will need to practice your new skills to get the most out of these programs.

A TEACHERS GUIDE

These programs represent a serious effort at providing a direct instructional adjunct to ongoing classroom instruction. As with any instructional material, they represent a synthesis of the authors' views as to the best approach to be taken for the instructional problem at hand, given the resources available and the expected context in which instruction is expected to occur.

This section of the documentation seeks to define the authors' model for instruction, explicate the instructional algorithms applied, suggest models for utilization, and finally, delineate potential modifications in the programs which make them more specifically tailored to individual classroom needs.

THE INSTRUCTIONAL MODEL:

Assumptions:

Several assumptions have been made about the learner population, the teacher, and the context in which the programs will be used:

1. Learners are assumed to have the entry level skills listed below:

   a. Addition of whole numbers, including the carrying of digits.

   b. Subtraction of whole numbers, including the borrowing of digits.

   c. Multiplication of single and multiple place numbers.

   d. Division of single and multiple digit numbers, with and without remainders.

   e. Addition, subtraction, multiplication, division, and reduction of fractions.

   f. Definition of terms related to each of these skills noted above.

   - addend
   - subtrahend
   - minuend
   - multiplicand
   - multiplier
   - divisor
   - dividend
   - quotient
   - remainder
   - numerator
   - denominator
   - lowest common denominator

2. Learners are assumed to have reading skills consonant with age and grade level placement in which these programs are to be offered.

3. Learners are assumed to have NO previous experience with, or skills in the operation of a micro-computer.

4. These programs are expected to be used in a school environment in which one or two computers are available in the school. There is no expectation of the availability of a computer for each learner.

5. Persons having instructional responsibilities with respect to these programs are NOT expected to need programming skills, nor are they expected to have substantial operating expertise in the use of the computer.

6. Most importantly, these programs are seen as a useful ADJUNCT to instruction, and not as a replacement for the direct instruction of the classroom teacher.

The Model:

Having started with these assumptions, a model was developed which hopefully will meet these definitions and serve to be developmental of new skills in learners. This model contains the following ingredients:

1. Learners are pre-tested in ascending order of skill hiearchy for the skills which are expected to be terminal at the end of the DECIMALS series.

2. A scoring algorithm generates a recommendation to the learner, indicating the presence or absence of

requisite skills, and suggests an appropriate starting point within the sequence of programs.

3. Each program begins with an introduction (instructional), which is immediately followed by a statement of intended learning outcomes (objectives). This statement of objectives serves as an "advanced organizer" for the learner.

4. Each program contains an instructional sequence in which the learner interacts with each conceptual construct as it is introduced.

5. After concluding the instruction sequence, the learner is presented with ten (10) problems, randomly generated, and within the constraints of the specific skill(s) being taught.

Algorithmic Considerations:

There are a number of concerns that purchasers of this set of programs will have regarding instructional algorithmic decisions which have been taken in the design of this series.

1. What about graphic displays and symbology?

The graphic displays which have been chosen represent some compromises between displays with an ideal level of clarity, and the inherent capabilities of the computer for graphic display.

Here are some of the discrepancies which resulted from these compromises:

a. Users will find an intermixture of large display numbers and smaller text generated numbers on the screen. This intermixture represents some compromise between the display capabilities of the computer, and the textual

requirements of the instructions presented on the screen. As units progress in complexity, greater use is made of the text printed numbers. This occurs both as the learner gains increasing familiarity and skill with manipulating the numbers, and as the density of the text accompanying the display increases.

All text is found to be displayed in upper case characters. This is consonant with the text routines that are ordinarily found in the Apple, and the Atari. Since the learner controls the duration of the display, legibility is not seen as a problem.

2. Trial and Error -vs- Error Cueing

The question of when and how to reinforce (reward) correct or incorrect learner response is likely to get as many divergent answers as there are users. The contention of the authors is that the computer's lack of response to some incorrect answers serves, in general, several purposes:

a. The computer will be, for most learners, a new, unfamiliar, and at times an anxiety producing tool for him to use. Overly large dosages of commentary by the computer relative to incorrect answers are not seen as helpful towards establishing a comfortable attitude toward this new tool. The computer simply not responding until a correct response is entered seems a far better way to engender positive attitudes toward both the computer, and the learning software.

b. Some who have used this program have commented that the learner can simply keep hitting any key, until the correct answer is found, and that in their view, only one response

should be allowed, correction indicated, and a new problem presented. Our answer to this is as follows:

We believe that in order for the learner to profit from this learning experience, he must be a participant in the management of his own learning; this implies that he must be a willing participant in having a useful dialogue with the computer. No matter how elaborate the scoring scheme, the learner can circumvent it by guessing, playing, or in other ways capriciously interacting with his terminal. We think the trial and error re-loop built in to many of the expected learner responses serves to both encourage experimentation, while at the same time requiring that the learner take responsibility for his own learning since no one else will do this for him.

3. Constructed -vs- Selected Response

All problem sets throughout these programs, including the pre-test, are answered by multiple choice response. Since the constructs being taught in DECIMALS are essentially both new, and at a level of abstraction significantly above the skills required to manipulate whole numbers, it seemed appropriate to narrow the range of work the learner must do to achieve a correct answer; in effect, the development of the selected response-tests provide the learner with both a starting point and some "hurdle help," which we think increases his willingness to attempt problem solution.

CLASSROOM UTILIZATION

The following are some applications which may be used by the classroom teacher in administering the fractions programs. The authors recognize that there

will be a large number of settings in which the fractions programs may be found and that the number of computers available to learners will vary greatly. Each of the following is a separate usage that is applicable in terms of the teacher's own organization of his or her classroom.

The Computer in the Learning Resource Center

In many instances in the elementary school a single computer will be available for instructional purposes. It may be found in a learning resource center or the school library with other audio-visual equipment. In this framework, teachers may wish to assign individual learners either remedial or advanced work by sending them to this area. Such utilization of the computer is the same as that of other supplementary materials found in the resource center.

We do not feel that the Pre-Test is a sufficiently powerful diagnostic instrument to serve on its own as a prescriptive tool for precisely specifying what unit in the series a learner should start with. Coupled, however, with other materials that the teacher has developed, the Pre-Test can serve to help the learner assess his own skills to point to the DECIMALS units he should enter.

If the teacher wishes to prescribe a specific unit, the learner should be told the Menu number to select. This allows the teacher to be a diagnostic resource for the learner.

Another instance in which the computer could well administer the entire series would be for younger learners who are doing well in their math curriculum and are being prescribed quest or accelerated activities. In this case the teacher can simply instruct the learner in the operating routines for the programs, and then allow them to proceed on their own.

It may be suggested that they proceed through the units at a pace which is comfortable for them.

Use of the Computer Within the Classroom Environment

In some instances, teachers will have a computer available within the confines of their own classroom. A single computer thus becomes a powerful adjunct to classroom instruction. There are several ways in which the teacher may choose to use the computer if it is available within the classroom.

1. For Group Instruction

With a single computer in the classroom, the teacher may choose to use that computer as a group instructional tool. If the computer is placed in the room such that two or more monitors are connected to it, the teacher can either do the data entry himself or may choose to have a learner do it, as classroom instruction is delivered to the entire watching class. The questions which appear on the screen can be answered by individual members of the class, with the teacher or a learner entering the correct response as provided by learners, and thus becoming a group interactive tool for the delivery of instrucion.

2. For Individual Remediation

Within the class, some learners will obviously need more help than others in dealing with the concepts involved in using decimals. Each of the learning programs may be prescribed by the teacher for individual learners having difficulty with specific skills in the use of decimals. Teachers can record how well the learner has done by looking at the score following the problem sets at the end of each of the units.

3. For Introductory Instruction

Just as there are learners who will be slower and need intensive remediation, there will also be learners who are ready to proceed more radiply than the rest of the class. The classroom computer can thus be used for quest or accelerated activities on the part of the individual learner.